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Experiment Station Work,

XI.

EXCESSIVE IRRIGATION.
CROSS-POLLINATION OF PLUMS.
ROOT PRUNING OF FRUIT TREES.
THE OXEYE DAISY.
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PREPARED IN THE OFFICE OF EXPERIMENT STATIONS.
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CONTENTS OF THE SERIES OF FARMERS' BULLETINS ON EXPERIMENT STATION WORK.

EXPERIMENT STATION WORK.

Editor: W. H. BEAL.

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ILLUSTRATIONS.

EXPERIMENT STATION WORK—XI.[1]

A DANGER FROM EXCESSIVE IRRIGATION AND THE REMEDY.

It has frequently been observed in the irrigated region that soils which showed no signs or only occasional small spots of alkali when first brought under cultivation have after the lapse of a comparatively few years become so widely impregnated with alkali as to render them completely or in large part unfit for the growth of the ordinary farm crops. The California Station has for a number of years devoted especial attention to the subject of the rise of alkali in soils, and recently the Division of Soils of this Department has undertaken a study of the causes and conditions favoring the rise of alkali in irrigated soils and the means of preventing or overcoming the injury resulting from it. A recent bulletin of the division gives an account of such investigations in the Yellowstone Valley near Billings, Mont.

These investigations indicate that the trouble in that locality at least is due largely, if not entirely, to injudicious or excessive irrigation. "Before irrigation was introduced the salts were present in rather large amounts, but well distributed throughout the soil, and not in such large quantities as to be injurious to crops." With the introduction of irrigation, however, water was applied in excessive amounts to the higher land, and seeping through to the lower soils carried with it the soluble salts, which accumulated in excessive amounts in the latter, especially where drainage was imperfect. Similar conditions have been reported by the California Station as existing in the San Joaquin Valley, California, and are known to occur in many other regions.

The bulletin of the Division of Soils above referred to states that "the open sandy lands, having better underdrainage, are not likely to

[1] This is the eleventh number of a subseries of brief popular bulletins compiled from the published reports of the agricultural experiment stations and kindred institutions in this and other countries. The chief object of these publications is to disseminate throughout the country information regarding experiments at the different experiment stations, and thus to acquaint our farmers in a general way with the progress of agricultural investigation on its practical side. The results herein reported should for the most part be regarded as tentative and suggestive rather than conclusive. Further experiments may modify them, and experience alone can show how far they will be useful in actual practice. The work of the stations must not be depended upon to produce "rules for farming." How to apply the results of experiments to his own conditions will ever remain the problem of the individual farmer.—A. C. TRUE, Director, Office of Experiment Stations.

be injured by a rise of salts except from an excessive application of water or in the low places in the path of the drainage system, especially when these are underlaid, as they are liable to be, by the heavy gumbo soils." It thus appears that the injury may not be due to the local application of water, but to the injudicious use of large quantities of water on neighboring farms or in places still farther away.

These investigations point clearly to * * * the necessity of great care in the application of water in irrigation. This care must be exercised not only for the land which is being irrigated, but for the adjoining lands on lower levels. * * * Where the damage has been done, or where the conditions are so imminent that ultimate ruin can be foreseen, the logical method of reclamation is in providing adequate systems of drainage to carry off the excess of water and the accumulated salts. * * *

It must not be assumed, however, that a thorough system of underdrainage relieves one from exercising care and judgment in applying water to the land. There is less immediate danger of ruining the land, to be sure, but there are two things to be considered, namely, that an excessive use of water means just so much loss to irrigation and so much less land which can be brought under the ditch, and also that, in the removal of these salts by the flow of the seepage waters out through the drainage system, large quantities of really valuable plant food are likely to be removed from the soil. * * * By overirrigation and underdrainage we may remove in a few years the very conditions which contribute to the wealth of the country in the fertility of the soil.

On this point a California Station bulletin states that while underdrainage is a ready and complete corrective of alkali, it does not follow that the indiscriminate use of underdrainage is to be recommended, since enormous amounts of valuable soil ingredients would thus run to waste. It therefore strongly urges that other remedial measures be given due consideration. Among the latter are deep and loose tilth of soil to check surface evaporation, and the culture of hoed crops and deep-rooted plants, which exert an influence in the same direction.—THE EDITOR.

CROSS-POLLINATION OF PLUMS.

The subject of pollination of cultivated plants has been vigorously exploited the last few years. Plums have shared conspicuously in the results of this general activity. The subject has already been touched upon in a former issue of this series,[1] but recent investigations, principally at the Vermont Station, have made important contributions to it.

For years it has been the experience of plum growers that certain varieties are unfruitful unless cross-pollinated. Investigations have added to the list of these varieties until now the Vermont Station has concluded that practically all sorts are self-sterile, the only positive exception being the Robinson. The fact of self-sterility of plums has been confirmed recently by observations at the Colorado Station. Hence mixed planting or intergrafting becomes practically a constant

[1] U. S. Dept. Agr., Farmers' Bul. 65 (Experiment Station Work—II), p. 17.

necessity. A knowledge of this fact leads naturally to the question, What variety should be selected to insure cross-pollination? This is one of the most intensely practical problems that the plum orchardist has to meet. Inasmuch as the cultivated plums are derived from several distinct species, it would seem probable that grouping varieties according to these species would indicate more or less exactly lines of affinity in pollination. In the case of the European plum this presumption is probably correct, though the experimental evidence is as yet inconclusive. It appears that under ordinary circumstances the domestica plums do not cross with native or Japanese varieties, but with the exception of this species probably all our commonly cultivated plums, both Japanese and native, are quite reliably interfertile.

Hence in planting native and Japanese plums the question of pollination affinities may be disregarded. The only precaution necessary in selecting varieties for mutual pollination is to ascertain that they blossom at the same time. This precaution, however, should be carefully observed, for the entire blossoming season of plums is of much longer duration than that of any one variety and the chances are that two varieties selected at random will not blossom simultaneously; for instance, in the latitude of Washington, D. C., the blossoming period of the different varieties cultivated extends over three to four weeks, while that of a single variety is rarely more than five days, often no more than three.

The length of time during which plum trees of any variety may remain in blossom and be subject to pollination is obviously a question of great importance. This varies greatly in different localities and different years. There are not sufficient data at hand to permit of a reliable generalization on this point, nevertheless the Vermont Station feels justified in making the following statements:

(1) Under circumstances of good weather the blossoms of a given variety are open and the stigmas receptive in sufficient number to insure the the setting of a full crop of plums for one to three days.

To be sure, a period of from ten to fourteen days may elapse between the opening of the first blossom and the falling of the last petals on a tree, but the real pollination that makes the crop is usually effected within a short time, frequently within three or four hours of bright sunny weather, between 10 or 11 o'clock in the morning and 2 in the afternoon.

(2) When the weather is bad a given variety may remain in blossom for an indefinitely long time, though usually there will not be a sufficient number of pistils in condition to set a crop through more than five to seven days.

But such long periods of blossoming do not indicate similar periods of receptivity for pollen. Although a tree may remain in bloom for so long a period through cold rainy weather, it is almost certain not to set any fruit. So well is this fact known that plum growers never

expect a half crop if the weather is persistently cold, cloudy, and wet during blooming time.

(3) When no pollen is available, or when by any means fecundation is prevented, stigmas will remain receptive four to six days even in sunny weather.

This fact may be of some importance in adjusting varieties to each other for mutual pollination. Repeated field observations have shown that if a blossom is not pollinated on opening it remains in a receptive condition for a considerable time. This fact also gives some margin of safety in combining varieties with the help of the diagram.

It is important also to know whether varieties blossom in the same sequence year after year. Observations at Denton, Md., and Geneva, N. Y., point toward the conclusion that they do. To test this point 20 representative varieties, selected at random, were arranged to show the variations in relative blossoming periods for four years and Wildgoose was taken as the norm of the comparison. With reference to it all the other varieties maintain the same order with a single exception, which might have been due to differences in soil or exposure. It seems fair to conclude that the variations from year to year in the order of blossoming are of small practical consequence in any given locality.

To determine whether the sequence of blossoming is the same in widely separated localities, a comparison was made of the order of blossoming of 25 varieties at Denton, Md., and the same varieties at Madison, Wis. This was considered a very severe test, not only because of the great differences in latitude and climate, but also because the blossoming season of 1898, when the tests were made, was unusually irregular, owing to much unsettled weather. Nevertheless the succession was nearly the same in both localities. The blossoming season of 22 out of 25 varieties at Madison did not vary over two days from the same varieties at Denton. The agreement was not, however, so striking and satisfactory as the agreement of blossoming dates in any one locality for a course of years. Further observations on this point at the Alabama Station indicate that in the South the sequence of blossoming is often not the same as in the North, and hence the Southern fruit grower should adopt Northern practice with caution.

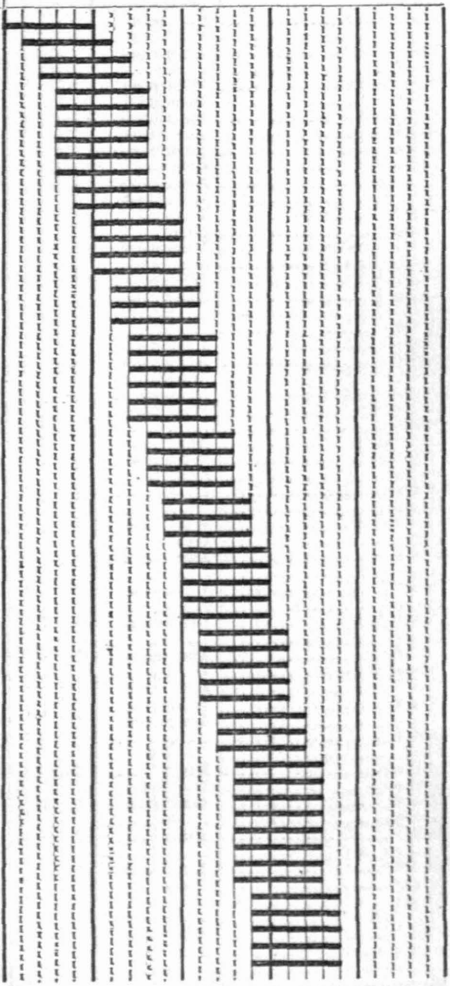
To aid in the selection of varieties for mutual pollination the Vermont Station has prepared a diagram showing the order in which over 200 sorts blossom. This diagram is reproduced herewith. The space between the vertical dotted lines represents an interval of time of one day. The length of time during which a variety is capable of successful pollination varies so greatly with meteorological conditions that no attempt is made to record it. Instead, an average blossoming period of five days for all varieties is assumed.

Order of blossoming of different varieties of plums.

Variety.	Group.
Wickson	Japanese
Red June	do
Burbank	do
Georgeson	do
Abundance	do
Aitkin	Nigra
Bailey *a*	Japanese
Mikado	do
Normand	do
Satsuma	do
Berckmans	do
DeCaradeuc	Marianna
Brill	do
Chabot	Japanese
Hale	do
Uchi Beni	do
Kelsey	do
Kerr	do
Yellow Japan *a*	do
Caddo Chief	Chicasaw
Early Red	do
Engre	Japanese
Marianna	Marianna
Ogeechee	Chicasaw
Shiro Smomo	Japanese
Longfruit	do
Maru	do
Ogon	do
Yosebe	do
Itasca	Nigra
Purple Yosemite	Americana
Wazata	Nigra
Hattie	Marianna
Hogg 2	Doubtful
Manitoba 4	Americana
Munson	Chicasaw
Robinson	do
Colleta	do
Excelsior	Hybrid
Willard	Japanese
Yellow Sweet	Americana
Yellow Transparent	Chicasaw
Clark	do
Emerson	do
Strawberry	Watsoni
African	Chicasaw
Arkansas Lombard	do
Beaty	do
Clifford	Wildgoose
Deepcreek	Americana
Newman	Chicasaw
Smiley	Wildgoose
Wildgoose	do
Cherokee	Americana
Des Moines	do
Drouth King	Wildgoose
El Paso	Chicasaw
Hughes	do

Relative order of blossoming.

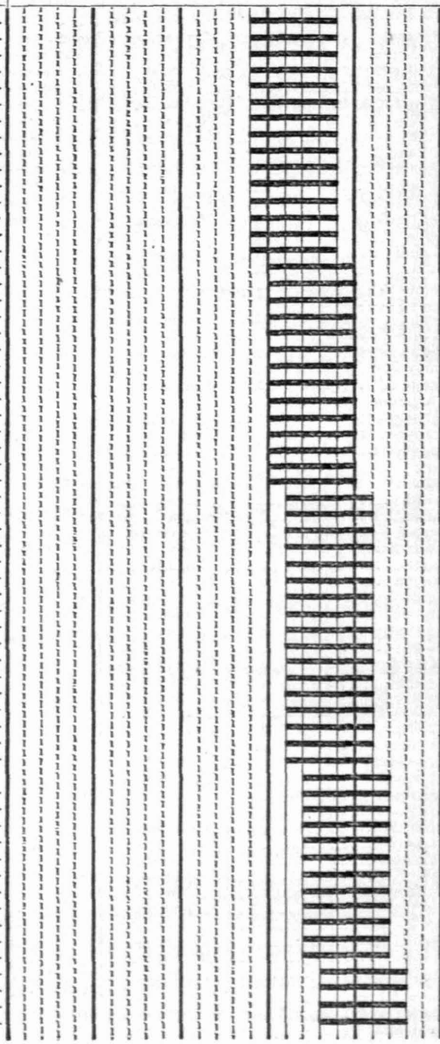
[The vertical dotted lines represent 1-day intervals, the heavy vertical lines 5-day periods. An average blooming period of 5 days (represented by the horizontal lines) is assumed for all varieties.]



a Bailey and Yellow Japan are now understood to be synonyms of Chabot; but the notes have been taken separately, and it did not seem wise here to attempt consolidation.

Order of blossoming of different varieties of plums—Continued.

Variety.	Group.	Relative order of blossoming. [The vertical dotted lines represent 1-day intervals, the heavy vertical lines 5-day periods. An average blooming period of 5 days (represented by the horizontal lines) is assumed for all varieties.]
Jefferson	Domestica	
Lonestar	Chicasaw	
Milton	Wildgoose	
Minnetonka	Americana	
Ocheeda	do	
Ohio Prolific	Wildgoose	
Richland	Domestica	
Rollingstone	Americana	
Spaulding	Domestica	
Speer	Americana	
Texas Bell	Chicasaw	
Weaver	Americana	
Wilder	Wildgoose	
Yellow Panhandle	Watsoni	
Cheney	Nigra	
Coe Golden Drop	Domestica	
Cumberland	Wayland	
Freeman	Wildgoose	
Gaylord	Americana	
Hiawatha	do	
Hilltop	do	
Lombard	Domestica	
Louisa	Americana	
Poole Pride	Wildgoose	
Pottawattamie	Chicasaw	
Roulette	Wildgoose	
Schley	do	
Sugar Drop	Americana	
Whitaker	Wildgoose	
De Soto	Americana	
Grayson	do	
Hawkeye	do	
Indian Chief	Wildgoose	
Juicy	Hybrid	
Kickapoo	Americana	
Muncy	do	
Osage	Wildgoose	
Parsons	Miner	
Poole Chili	Domestica	
Reine Claude	do	
Rockford	Americana	
Sucker State	Wayland	
Van Buren	Americana	
Wooten	Wildgoose	
Wyant	Americana	
Zuzac	do	
Clara	(?)	
Clinton	Miner	
Columbia	Wayland	
Dakota	Americana	
Heaton	do	
Idall	Miner	
Indiana Red	do	
Le Duc	Americana	
Miner	Miner	
Piram	Chicasaw	
Silas Wilson	Americana	
Sophie	Wildgoose	
American Eagle	Americana	
California	do	
Champion	do	
Chas. Downing	Wildgoose	

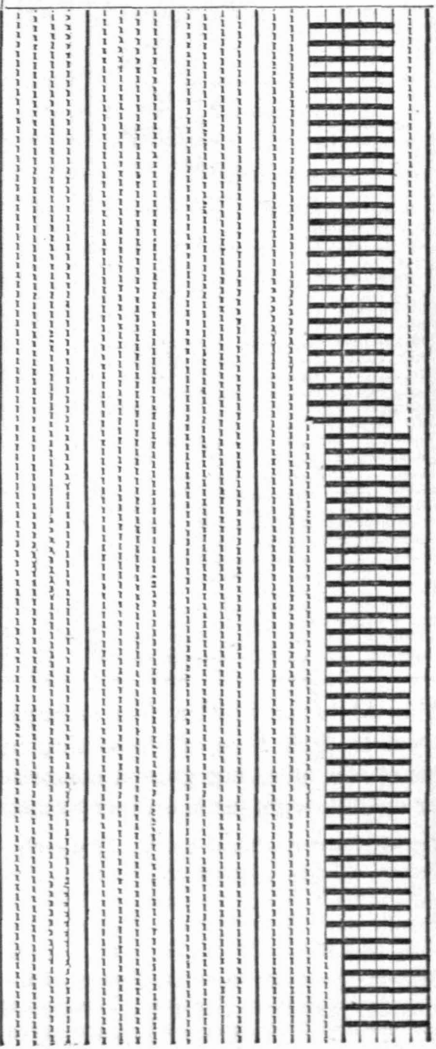


Order of blossoming of different varieties of plums—Continued.

Variety.	Group.
Cluck	Chicasaw
Comfort	Americana
Communia	Domestica
Dunlop 2	Wildgoose
Forest Rose	Miner
Garfield	Wayland
Hammer	Americana
Iris	Miner
James Vick	Wildgoose
Jewell	do
Jones Late	Americana
Kampeska	do
Knudson Peach	do
Kopp	do
Kroh	Wildgoose
Mankato	Americana
Moreman	Wayland
North Carolina	Americana
Old Gold	do
Prairie Flower	Miner
Quaker	Americana
Seper Peach	Nigra
Shropshire Damson	Domestica
Surprise	Miner
Wolf	Americana
Apricot	do
August	do
Bender	do
Carver	do
Colorado Queen	do
Comptine	do
Cottrell	do
Crescent City	Miner
Forest Garden	Americana
Golden Beauty	Wayland
Hanson	Americana
Honey	do
Ida	do
Large Red Sweet	do
Macedonia	Wildgoose
Maquoketa	Miner
Marcus	Americana
Maryland	Hybrid
Miller	Americana
Missouri Apricot	Wayland
Moore Arctic	Domestica
Noyes	Miner
Rachael	Americana
Rebecca	do
Red Panhandle	Watsoni
Stoddard	Americana
Van Deman	do
Washington	Domestica
Wayland	Wayland
Wildrose	Americana
Williams 17	do
Worldbeater	Wayland
Prunus besseyi	Sand cherry
Cook's Choice	Americana
Compass Cherry	Hybrid
Eldora	(?)
Forewattamie	Hybrid

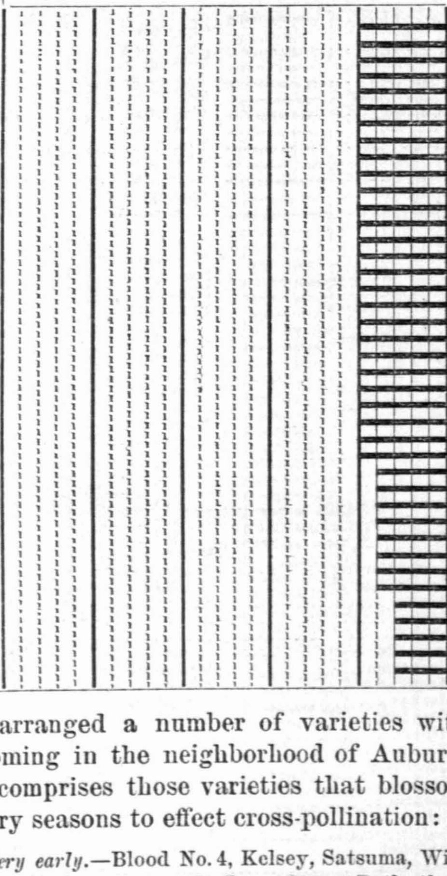
Relative order of blossoming.

[The vertical dotted lines represent 1-day intervals, the heavy vertical lines 5-day periods. An average blooming period of 5 days (represented by the horizontal lines) is assumed for all varieties.]



Order of blossoming of different varieties of plums—Continued.

Variety.	Group.	Relative order of blossoming. [The vertical dotted lines represent 1-day intervals, the heavy vertical lines 5-day periods. An average blooming period of 5 days (represented by the horizontal lines) is assumed for all varieties.]
Gold (Terry)	Americana	
Heideman 88	do	
Hollister	Wildgoose	
Illinois Ironclad	Americana	
Iona	do	
Iowa	do	
Irene	do	
Italian Prune	Domestica	
Kanawha	Wayland	
Kieth	Americana	
Late Rollingstone	do	
Leonard	do	
Leptune	Wayland	
Magnum Bonum	Domestica	
Marion	Americana	
Moon	do	
Moreman Prune	Wayland	
Nebraska	Miner	
Newton Egg	Americana	
Pendent	do	
Penning Peach	Nigra	
Reed	Wayland	
Sloe	Americana	
Smith Red	Nigra	
Waraju	Americana	
Wier Large Red	Miner	
Wood	Americana	
Choptank	Wildgoose	
Davis	do	
Esther	Miner	
Galena	Americana	
Prunus maritima	Maritima	
Moreman Cherry	Wayland	
Reche	Americana	
Winnebago	do	
Holt	do	
Joe Hooker	do	
Pfeffer Premium	do	
Shipper's Pride	Domestica	
Bradshaw	do	



The Alabama Station has arranged a number of varieties with respect to their time of blossoming in the neighborhood of Auburn. Each of the following groups comprises those varieties that blossom near enough together in ordinary seasons to effect cross-pollination:

Earliest bloomer.—Blood No. 3. *Very early.*—Blood No. 4, Kelsey, Satsuma, Wild Chicasaw, Wickson, Excelsior, Emerson, *Prunus pissardi*, Lone Star. Both these groups bloom before peaches and are liable to be killed by spring freezes. *Early.*—Burbank, Mariana, Berckmans, Chabot, Botan, Bailey Japan, Yellow Japan, Hattankio, and Babcock. These bloom about with the early-blooming peaches. *Medium.*—Yellow-fleshed Botan, Munson, Babcock, Orient, Berger, Gold, Red June, Normand, Abundance, Rockford, Transparent, Wildgoose, Wooten, Botan, Kerr. These bloom with the later peaches, and are comparatively safe from frost. *Late.*—Maru, Long Fruited, Red Nagate, Golden Beauty, Newton, President Wilder, Wayland, Chas. Downing, Weaver, Milton, Whittaker. *Very late.*—Ogon, Willard, Hammer, Wyant, Yosobe, and Hawkeye.

In selecting a pollenizer for a variety, select one that blossoms at the same time. This can easily be done by reference to the preceding diagram. In the North the whole blossoming season of plums is considerably shorter than in the South, and the blossoming seasons of single varieties overlap more; hence it is necessary to take greater precautions in the South than in the North that both varieties blossom at exactly the same time.

The diagram does not show the times at which the different varieties blossom. It simply indicates their order of blossoming. The exact date is, of course, a matter of latitude and local conditions. In order to indicate in a general way the blossoming season and its progress in different parts of the country, the Vermont Station has prepared a

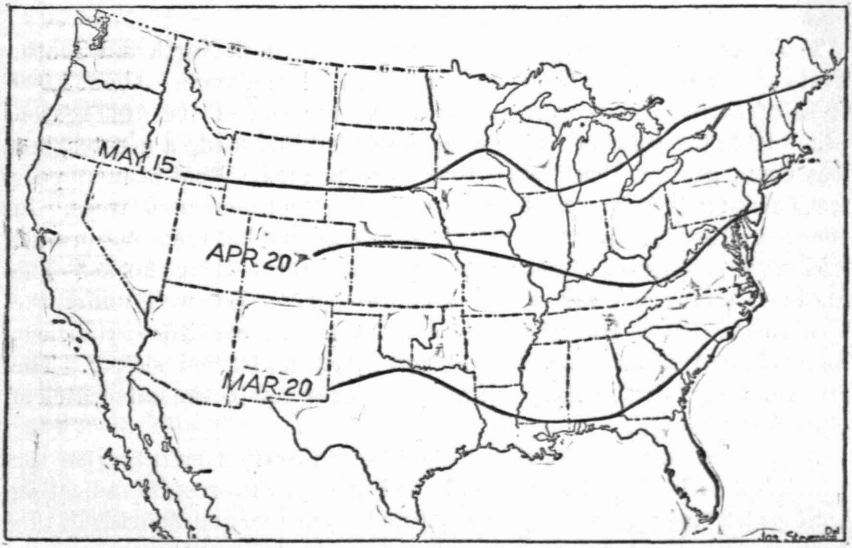


FIG. 1.—Chart showing the blossoming season of the Wildgoose plum in 1898.

chart (fig. 1) showing the blossoming season of the Wildgoose plum for 1898. The heavy lines show the point at which the Wildgoose plums were in blossom on the dates indicated. The date at which any other variety blossoms along these lines may be estimated approximately, though not exactly, by adding or subtracting as many days from these dates as the variety blossoms earlier or later than the Wildgoose, as shown in the blossoming chart.—V. A. CLARK.

THE CLOSE ROOT PRUNING OF FRUIT TREES.

For several years a method of root pruning much at variance with commonly accepted methods has been strongly advocated in certain quarters. Although for some time the new views gained little credence, the advantages of the method over older ones were represented as being so great and the results claimed for it so surprising that

horticulturists could not be other than interested in tests of its practicability.

The method consists in cutting back a transplanted tree to practically no root at all or at most to a mere stub, shortening the top proportionately. The tree thus becomes to all intents and purposes a cutting. There is nothing essentially "new" about this method. Interest in it attaches to the proposition that its possibilities in practice have not been fully understood.

The advantages claimed for this method are that it gives a better tree with a root system consisting of several strong roots which penetrate into the moist depths of the soil and securely anchor the tree instead of spreading out near the surface. Moreover, with the root pruned to a club, it is no longer necessary to dig large holes in transplanting. A mere dibble hole is sufficient.

The method has been quite extensively tested both North and South. Tests were made at the Maryland Station on a large scale. About 1,000 trees of various kinds were planted. At the end of the first season peach trees the roots of which were unpruned had made a greater, but less even, growth than those that were pruned. Root-pruned pear trees made a better growth in all respects than unpruned trees. In the case of apples there was little if any difference between root-pruned and unpruned trees. Root-pruned plums outgrew their checks. The Mahaleb cherry, red cedar, and California privet did well under the treatment. Black Tartarian cherry on Mazzard roots, Norway spruce, hemlock, and Lawson cypress did not. Altheas started slowly. The general result of the tests was very encouraging to the advocates of close root pruning.

A series of tests was made by the Georgia Station, mainly with the peach but including also the apple and cherry, with results indicating that peach trees pruned by this method "will live and flourish in this section even in stiff clay soil and under adverse meteorological conditions. This statement may also be extended to cover apples and cherries."

The Alabama Station planted peaches and pears on a hard, gravelly hillside having stiff clay subsoil, with the result that at the end of the season "no increased vigor was observed in the root-pruned trees, but on the other hand no disadvantage could be detected, and the conditions could hardly have been more severe." The New Jersey Stations have also tested the method with satisfactory results.

The method was tested at the Indiana Station. The season was considered exceptionally favorable. "The result of this experiment showed that the peach tree was capable, after being deprived of all its roots and branches, of producing a magnificent root system and a top to correspond. The dwarf pear, standard pear, German prune, and Early Richmond cherry came next in order, the latter making very little root development on the pruned trees."

Not all tests, however, have resulted favorably. Of 25 apple trees planted at the Nebraska Station in the spring of 1896, only 10 were living at the end of September in the same year, and very few of these showed any satisfactory growth or vigor. Of the check trees, some having the roots cut back only about one-half and others untrimmed, not one died. From tests made at the Missouri Station with the apple, it was concluded that "the injury caused by too close root pruning is one that trees do not outgrow if they do not die outright. * * * The heroic pruning advised by our southern neighbor seems to be unadapted to our conditions. The mortality among our trees is too great."

From the results of all the trials thus far reported, it is evident that this practice of close root pruning neither merits unqualified approval nor deserves sweeping condemnation. As might have been expected, species vary greatly in their ability to endure severe root pruning. Among cultivated trees, probably those which experience the least ill effects are the peach and pear. On the other hand, the persimmon is a tree to which this method probably would not be applicable, as it is liable to die if very much of its long taproot is cut off.

The critics of this method have attributed much of its success to conditions of soil and climate. On this point the evidence is very unsatisfactory. Stringfellow, the most ardent advocate of the method, working at Galveston with the favoring conditions of a warm, porous soil and high annual rainfall, has obtained remarkable results from close root pruning; but the Georgia and Alabama stations have also obtained satisfactory results under the adverse conditions of drouth and poor, hard soil. These results certainly contradict the statements of certain critics, that the method is successful only under favorable soil and meteorological conditions. Again, nearly all of these successes were achieved in the Middle and Southern States. The outcome under equally unfavorable conditions in the North might be different; in fact at present the evidence points in that direction. Much field work is still necessary to determine the limits of applicability of this method.—V. A. CLARK.

THE OXEYE DAISY.

This familiar plant, known to botanists as *Chrysanthemum leucanthemum*, is at the same time a beautiful flower and a pernicious weed. Like most weeds, it thrives on neglect, and if left unchecked rapidly establishes itself in fields to the exclusion of more useful, though less attractive, plants.

The New Hampshire Experiment Station is authority for the statement that "it can be kept from farms if precaution is exercised." A method commonly employed for this purpose is to cut the hay early and thus prevent the maturing of seeds. Experiments by the New Hampshire Station indicate that it requires at least twelve days after the

daisy blossoms for its seeds to mature so that they will germinate. Therefore, if the plant is cut within this period, reseeding is effectually prevented.

As the oxeye daisy so frequently occurs in hay fields and often forms an important component of the hay secured from such fields, it will be of interest to compare the composition (as regards food constituents) of the plant with that of average timothy hay. The Massachusetts State Experiment Station has made an analysis of the daisy. The results of this analysis, together with the average of a large number of analyses of timothy hay, are given in the following table:

Food constituents of the oxeye daisy and timothy hay.

	Water.	Protein.	Fat.	Nitrogen-free extract.	Fiber.	Ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Oxeye daisy	9.7	6.9	2.1	41.3	33.6	6.4
Timothy hay	13.2	5.9	2.5	45.0	29.0	4.4

The table shows that, as far as chemical composition is concerned, the oxeye daisy is fully the equal of timothy hay in nutritive constituents. In judging of the feeding value of a substance, however, other things besides chemical composition must be taken into account, such as digestibility, palatability, etc., and these have not been studied in the case of the daisy as they have in case of timothy hay.

It will also be of interest in this connection to know what draft the daisy makes upon the fertility of the soil. According to an analysis made by the Massachusetts Station 1 ton (2,000 pounds) of oxeye daisy hay withdraws from the soil about 25 pounds of potash, 8.7 pounds of phosphoric acid, 22 pounds of nitrogen, and 26 pounds of lime. To restore the stated amounts of the first three constituents to the soil it would be necessary to apply about 50 pounds of muriate of potash, 65 pounds of superphosphate, and 140 pounds of nitrate of soda.—THE EDITOR.

POISONING BY WILD CHERRY LEAVES.

While the number of poisonous plants as compared with those that are harmless or useful is small, such plants are widely distributed and cases of poisoning of man and animals are frequently reported. The Division of Botany of this Department has issued two bulletins, one of them a farmers' bulletin, which treat of some fifty or more plants which are known to have caused injury to man or animals in the United States.

The great injury done to stock, especially in those regions where loco weeds and larkspur abound, has led a number of stations to devote considerable study to the subject of plants poisonous to stock. Publications on the subject have been issued by the experiment stations in Colorado, Iowa, Kansas, Montana, New Jersey, New Mexico, North Carolina, Oregon, South Dakota, and other States.

During the past year the New Hampshire Station has issued a bulletin relating to the poisonous properties of the leaves of the wild cherry, especially the wild black cherry. Examinations showed that the leaves contain a small quantity of prussic acid, and when eaten in considerable amounts enough of that deadly poison is secured to kill cattle. Analyses showed the content of prussic acid to be greatest in leaves that had been wilted until they began to appear slightly limp and had lost their gloss. Vigorous succulent leaves from young sprouts, such as are most liable to be eaten by stock, are far more poisonous than leaves from a mature or stunted tree. While the wilted leaves are most poisonous, the fresh leaves are also dangerous, and even the dead leaves are not wholly above suspicion. The leaves of other varieties of cherry, especially the choke cherry, are also poisonous, although to a somewhat less degree than those of the wild black cherry. Chemical examination of the leaves of plums, peaches, etc., plants closely related to the cherry, showed the absence of the poisonous principle in the plum leaves, but revealed the presence of a considerable amount in the peach leaves.

Poisoning from these sources if severe is so quickly fatal that little can be done for stock affected. Care should be exercised that such material, especially when wilted, should be kept away from stock.—W. H. EVANS.

PRESERVING EGGS IN WATER GLASS.

A bulletin of the North Dakota Experiment Station calls attention to the need of a simple method which will enable farmers, poultrymen, and even consumers to put away eggs during the summer months when they are plentiful and cheap, and preserve them in good condition until the winter months, when they are scarce and dear and fresh eggs can not be obtained; and reports trials of various methods of preservation.

The spoiling of eggs is due to the entrance of air carrying germs of decomposition through the shells. Normally the shell has a surface coating of mucilaginous matter, which prevents the entrance of these harmful organisms into the egg for a considerable time; but if this coating is removed or softened by washing or otherwise, the keeping quality of the egg is much reduced. These facts explain why the common methods of preservation have not been entirely successful, and suggest that the methods employed should be based upon the idea of protecting and rendering more effective the natural coating of the shell, so that air bearing the germs of decomposition may be completely excluded. "At the present time eggs are largely packed in lime, salt, and other products, or are put in cold storage for winter use, but such eggs are very far from being perfect when they come upon the markets." According to the experiments made by the North Dakota Station, water glass more closely conforms to the requirements of a good preservative than any of the substances commonly employed. It was found

in these experiments that a 10 per cent solution of water glass preserves eggs so effectually that "at the end of three and one-half months eggs that were preserved the first part of August still appeared to be perfectly fresh. In most packed eggs, after a little time, the yolk settles to one side, and the egg is then inferior in quality. In eggs preserved for three and one-half months in water glass the yolk retained its normal position in the egg, and in taste they were not to be distinguished from fresh, unpacked store eggs. Again, most packed eggs will not beat up well for cake making or for frosting, while eggs from solution in water glass seemed quite equal to the average fresh eggs of the market."

Of twenty methods of preserving eggs tested in Germany, the three which proved most effective were coating the eggs with vaseline, preserving them in limewater, and preserving them in water glass. The conclusion was reached that the last is preferable, because varnishing the eggs with vaseline takes considerable time and treating them with limewater is likely to give the eggs a disagreeable odor and taste. "There is, however, one drawback with eggs preserved in a solution of water glass, viz, that the shell easily bursts in boiling water. This may be avoided by cautiously piercing the shell with a strong needle."

The following directions for preserving by this method are given:

Use pure water that has been thoroughly boiled and then cooled. To each 10 quarts of water add 1 quart of water glass. Pack the eggs in a jar and pour solution over them, covering well.

Keep the eggs in a cool dark place. A dry cool cellar is a good place.

If the eggs are kept in too warm a place the silicate is deposited and the eggs are not properly protected. Do not wash the eggs before packing, for by so doing you injure their keeping quality, probably by dissolving the mucilaginous coating on the outside of the shell.

For packing, use only perfectly fresh eggs, for stale eggs will not be saved and may prove harmful to the others. * * *

Water glass is a very cheap product, that can usually be produced at not to exceed 50 cents per gallon, and 1 gallon would make enough solution to preserve 50 dozen eggs, so that the cost of material for this method would only be about 1 cent per dozen. Water glass is sodium and potassium silicate, sodium silicate being usually the cheaper. If wooden kegs or barrels are to be used in which to pack the eggs, they should first be thoroughly scalded with boiling water, to sweeten and purify them.

—THE EDITOR.

THE PERIOD OF GESTATION IN COWS.

A recent bulletin of the New York Cornell Experiment Station reports observations since 1889 on the period of gestation of all of the cows of the university herd, which "has contained an average of about 20 cows, about two-thirds Holstein and high-grade Holstein, one-third Jersey and high-grade Jersey, and a few native, mixed, and crossbred cattle. Nearly all the animals were bred and raised on the farm from dams so bred and raised, so that the observations were taken from a

single herd and its descendants. In all, 194 observations have been made; of these, 9 terminated in the birth of dead calves prior to 253 days of pregnancy and 3 more were doubtful, so that the 12 have been excluded and the averages confined to the 182 births that may be considered normal."

Of the 182 births, the average period of gestation was almost exactly 280 days. The shortest period was 264 days; the longest 296 days. Approximately equal numbers of births occurred on each day from the 274th to the 287th, inclusive.

The period of gestation was the same for male and female calves. The period of gestation where twins were born was five days less than the general average and eight days less than the average of the single births of the same cows. Many cows show a well-marked individual characteristic as to period of gestation, which may be several days longer or shorter than the average.

THE LONG CLAM.

A recent bulletin of the Rhode Island Station calls attention to the rapid disappearance of a valuable article of food, viz, the long clam, which was formerly so abundant along the shores of New England. "The supply necessary to meet the enormous demand of home consumers and of shore resorts is almost entirely derived from the coasts of Long Island and of Maine at a sacrifice both in quality and in price. Yet we have remaining to us all conditions necessary for producing from Narragansett Bay enough clams to supply not only Rhode Island, but all sections of the country whither clams can be profitably transported, provided the flats are made to produce, or even allowed to produce, to their full capacity."

The causes of the disappearance of the clam are (1) a demand exceeding the supply; (2) a continued diminution of "breeders," resulting in a decreasing "set;" (3) indiscriminate turning over of the flats, resulting in the destruction of a large proportion of the young, unmarketable clams; and (4) the destruction of breeding grounds by the dumping of refuse, factory wastes, and sewage in rivers and coast waters. "If the conditions under (3) are ameliorated, the stress of (1) and (2) will be lessened, and the result will be immediately felt in a larger supply of clams and a fall in price consequent upon the increased and cheapened production, which will be a benefit to the entire population."

Clams flourish not only on open seacoast where sufficient protection is offered against the shifting sands, but even far from the sea, in the brackish bays and estuaries. Indeed, areas of brackish water having a suitable bottom are the most prolific in clams, since in such localities grow the greatest abundance of microscopic plants (diatoms), and every such area which is exposed at low tide should be utilized for growing clams.

The clam is even better adapted than the oyster for artificial cultivation. The chances of failure in the "set" are smaller; the number of enemies is fewer; the cost of getting a "set of seed" is smaller; and the cost of planting is eliminated, for, if the bottom is suitable, clams can not be kept out. The cost of digging may equal or perhaps be somewhat larger than that of dredging oysters on an extensive

scale. Most important of all is the extreme simplicity of the cultural operations; with the conditions once secured, nothing remains but the harvesting. An acre of good "clam ground" should yield annually 500 bushels of marketable bivalves.

A clam farm should consist of several divisions. The preserve, or ground for breeders, where mature clams are kept in numbers sufficient to seed the rest of the farm without further attention, the proper number may be determined by experiment. Patches of seaweed should be left, to furnish points of attachment for the young clams. The balance of the farm should be divided in sections, to be dug only on successive years, allowing three or four years between digging of the same area, thus preventing the destruction of the young clams. This plan, if pursued, will add considerably to the market value of the clams, as the marketable clams on each area will be of nearly uniform size, but of a different size on every other area, so that the most satisfactory size for any particular use will be available.

—THE EDITOR.

SILAGE FOR HORSES AND HOGS.

Horses.—When silage was first introduced cases of sickness in horses attributed to its use were frequently reported, and the opinion that silage was not suited to horses came to be quite widely entertained. Evidence has accumulated, however, that good silage used with proper care is a safe and valuable food for horses.

In experiments at the Virginia Station with 8 work animals (6 mules and 2 horses), 4 of the animals were fed only hay and corn and 4 were fed corn silage in addition, the silage replacing a part of the corn. During a preliminary period the animals were gradually accustomed to the silage, only a small amount being fed at first, but during the last six weeks of the experiment the animals were fed all the silage they would eat. The amount consumed varied from $52\frac{1}{2}$ to $174\frac{1}{2}$ pounds per week—less than "is readily devoured by cattle of the same weight." The animals remained in good health throughout the experiment and gained in weight, although constantly at work except in stormy weather.

As a whole, it would appear that silage would make a good roughage for horses when used in connection with hay or stover and grain, but that the animal should become accustomed to the food by degrees, and that this is as important as when changing from old to new corn or from hay to grass. For some days, when beginning to feed silage, it is of the utmost importance to feed a very small amount at first, and increase gradually as the animal's appetite and condition of bowels may indicate.

It is probable that the bad effects observed in the use of silage "came from feeding too freely at first, or possibly, too, from not realizing that all good silage contains a large amount of corn. If this is not taken into consideration, and a large ration of corn is given besides, it may prove dangerous, or at least give serious bowel trouble."

Hogs.—In this connection it is interesting to note the results of experiments at the Virginia Station in feeding corn silage to hogs. It was found that the silage "was economical to use in conjunction with corn as a maintenance ration, but not so if used alone." Two brood sows were fed for seven weeks, during winter, exclusively on silage, the

amounts fed per week being 49 pounds in one case and 56 pounds in the other. Of this from 8 to 10 pounds were wasted by the animals. The animals lost weight, and their general appearance at the end of the experiment "was such as to discourage the further use of silage as an exclusive ration for hogs, though in after-fattening these took on flesh as rapidly as did the ones fed corn, showing that the exclusive use of silage had not impaired the digestion."

In the experiments in which the silage constituted only a part of the ration, the animals consumed from 28 to 35 pounds of silage and 14 to 21 pounds of corn on the cob per week during a period of ten weeks. The animals were kept in good condition through a severe winter on this ration. By using the silage a saving of nearly one-third in the cost of feed was effected.

Experiments at other stations have not generally been very favorable to the use of silage as a food for swine; nor do the results of experiments at the Virginia Station do more than indicate that silage is worthy of consideration as a component of a cheap maintenance ration, to be used for such purposes as carrying brood sows over winter, and not for fattening.—THE EDITOR.

COMMERCIAL BUTTER CULTURES USED IN CONNECTION WITH PASTEURIZED CREAM.

A recent report of the permanent butter exhibitions in Denmark states that out of 713 creameries exhibiting during 1898 all but 5 practiced pasteurization, and all but 11 used commercial starters for ripening the cream. This very general use of pure cultures and pasteurization in Denmark, taken in connection with the attempts to extend the export of American butter to England, which is the chief market for the Danish product, lends special interest to investigations on the adaptability to this country of the methods practiced in Denmark.

Some of these investigations have been previously noticed.[1] The latest contribution is from the Pennsylvania Station. Comparisons were made between ripening cream with three commercial cultures and a skim-milk starter prepared at the station. In each comparison cream was also allowed to ripen naturally without any starter. Both pasteurized and unpasteurized cream was ripened in the above manner, and the effect on the flavor was noted by competent judges soon after the butter was made. The milk was pasteurized by heating it to 150° F., at which temperature it was kept for twenty minutes, after which it was cooled to 55° F. One of the commercial cultures and the skim-milk starter were acid-producing starters, while the other two cultures did not produce acid. Consequently the pasteurized cream in which the last two cultures were used lacked the amount of acid usually developed in normally ripened cream.

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[1] U. S. Dept. Agr., Farmers' Bul. 92 (Experiment Station Work—IX), p. 23.

When pasteurized cream was used the nonacid-producing cultures gave results slightly inferior to those obtained with the control lots from unpasteurized cream ripened spontaneously, while the acid-producing starters (a commercial culture and the skim-milk starter) gave results slightly better than the control lots. Where the cream was not pasteurized the use of the commercial cultures gave scarcely any perceptible improvement over allowing the cream to ripen naturally. The butter made from pasteurized cream ripened with any of the four cultures used was more uniform in flavor than the control lots, and this was especially noticeable in the case of cream ripened with the acid-producing commercial culture and with the acid-producing skim-milk starter.

The authors draw the following conclusions:

According to our present standards of flavor, nothing was gained by using a commercial culture, either with pasteurized or unpasteurized cream. In using the cultures in pasteurized cream the nonacid-forming cultures had if anything an injurious effect upon the flavor, and where they were used in the raw or unpasteurized cream the flavor produced was but little if any different from that of the control lots.

That these commercial acid-forming ferments offer little inducement to their use is evinced by the results of these trials and by the fact that a carefully prepared skim-milk starter gave practically as good results as the commercial cultures used. * * *

Close attention to details, cleanliness, and the careful selection of milk at the weigh room promise more in improving the flavor of our butter than pasteurizing and the use of pure cultures.

So much has been said in favor of pasteurizing milk or cream for butter making and using pure cultures that many have been led to believe it to be the solution of the whole matter in butter making. Continuous pasteurizers for pasteurizing the whole milk before separation have been placed upon the market, and have been sold and used to some extent. The authors believe, however, that the results obtained by pasteurization have not, as a rule, justified the expectations based upon the theory of the process and upon the results obtained in other countries. It may be noted in this connection that one of the chief claims of the advocates of pasteurizing and using pure cultures is the improved general keeping qualities of the butter and the retention of flavor. The experiments described above tested only the immediate effect upon the flavor. It is possible that in keeping a more marked difference, due to pasteurization or the use of cultures, would have been apparent. It is also quite possible that greater differences due to this treatment would have been apparent in ordinary creameries than in the college creamery. The question as to the advisability of employing these methods under the ordinary conditions prevailing in this country is a mooted one, and must be regarded as not fully demonstrated by the careful work done at several experiment stations.—E. W. ALLEN.

THE STAVE SILO.

The value of silage, properly made and properly fed, is no longer questioned. "Especially to the dairy farmer has the silo become an almost necessary adjunct to the equipment of the farm." This being true, the proper construction of silos becomes a question of the highest importance. A silo adapted to general use must be cheap, durable, simple in construction, and effective in preserving the silage. According to a bulletin of the New York Cornell Station the stave silo fully meets these requirements and "is the most practical and successful silo which can be constructed." The same bulletin makes the following suggestions regarding the construction of stave silos:

Convenience in feeding should determine the location of the silo. Its bottom should be on a level with the floor on which the silage is to be fed. It is cheaper to elevate the silage at the time of filling the silo, when it can be done on a carrier by steam power, than to elevate it in baskets at time of feeding when it must usually be done by man power. The practice of digging pits into which to put the silage is not to be commended, as it causes an unnecessary expense at the outset and is afterwards a source of extra labor and annoyance when the silage is fed. The silo may be placed inside or outside of the barn as circumstances render advisable.

In calculating the amount of silage which will likely be needed, it is customary to estimate that a 1,000-pound cow will consume about 40 pounds or 1 cubic foot of silage per day. This gives a basis upon which to calculate the capacity of the silo required to carry a certain amount of stock. * * * The following table shows the approximate capacity in tons of silos of various depths and diameters:

Approximate total capacity of cylindrical silos for well-matured corn silage.

Depth.	Inside diameter in feet and capacity in tons.										
	12.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
20 feet	45	70	80	90	101	113	125	138	151	167	180
21 feet	47	74	84	95	106	118	132	145	159	173	190
22 feet	49	77	88	99	111	124	138	152	166	182	198
23 feet	52	81	92	104	117	130	144	159	174	190	207
24 feet	54	84	96	108	122	135	150	166	179	199	216
25 feet	56	88	100	113	127	141	157	173	189	207	225
26 feet	59	92	104	118	132	147	163	180	197	215	235
27 feet	61	95	108	122	137	153	169	187	205	224	244
28 feet	63	98	112	126	142	158	175	193	212	232	252
29 feet	65	101	116	131	147	164	182	200	220	240	262
30 feet	67	105	120	136	152	170	188	207	227	249	271

* * * The table gives the capacity of silos could they be filled with settled silage. Practically this is never possible. If the silo is filled with well-matured corn, and then after the silage has settled is filled again, and this is repeated two or three times, we can get only about three-fourths the maximum capacity of the silo in settled silage. If the silo is filled but once and is not refilled after the silage has settled, not more than two-thirds the capacity of the silo can be obtained in settled silage. Thus, if the silo can be filled in the manner first mentioned one should be constructed which has a maximum capacity one-third greater than for the amount of silage required. If the silo is to be filled rapidly and not refilled after settling, it should have a capacity one-half greater than for the actual amount of silage required.

A foundation 3 or 4 inches deep should be laid of stone and gravel well packed down and finished with cement. The diameter of this foundation should be at least 2 feet greater than that of the proposed silo.

The silo is set up as shown in fig. 2, which shows a cross section of one method of construction.

The posts (*a, a, a, a*) should be of 6 by 6 material and run the entire length of the silo. These should be first set up vertically and stayed securely in place.

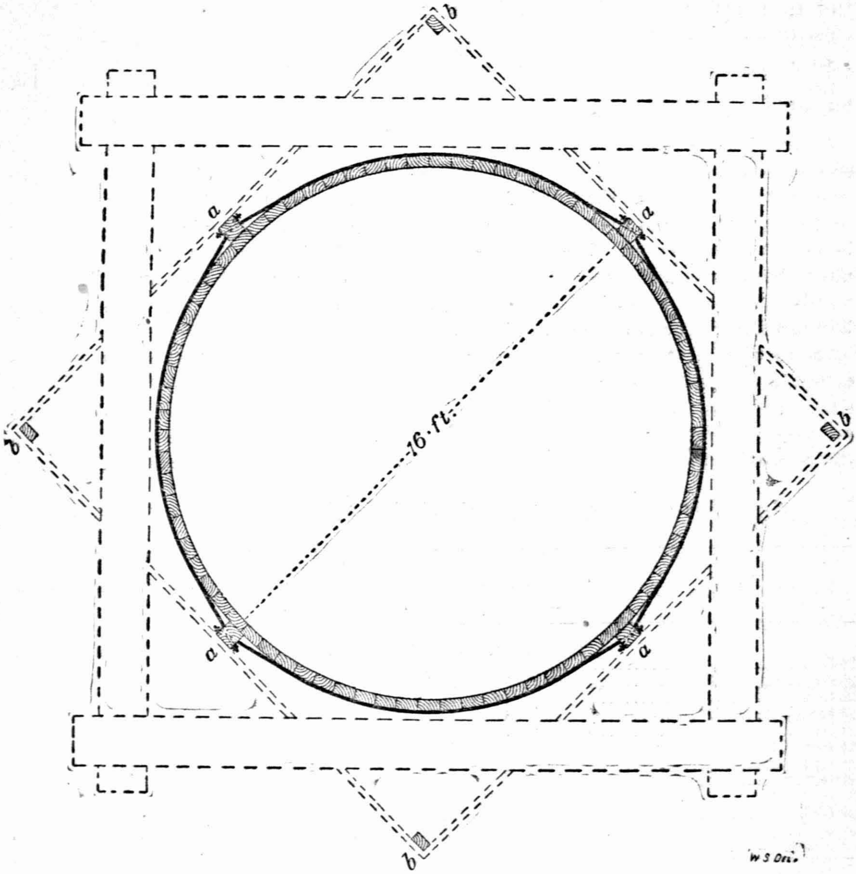

FIG. 2.—Cross section of stave silo. The dotted lines show how scaffolding may be put up.

* * * The scaffolding may be constructed by setting up 2 by 4 scantling in the positions shown in fig. 2 as *b, b, b, b*. Boards nailed from these 2 by 4 scantling and to the 6 by 6 posts will form a rigid framework across which the planks for the scaffold platform may be laid. Before the scaffolding is all in place the staves should be stood up within the inclosure; otherwise difficulty will be experienced in getting them into position.

It is probable that no better material can be obtained for the staves than Southern cypress. This, however, is so expensive in New York State as to preclude its use in most cases. Of the cheaper materials hemlock, white pine, and yellow pine are usually the most available. At the present time hemlock is one of the cheapest satisfactory materials which can be purchased, and it is probably as good as any of the cheaper materials. It should be sound and free from loose knots.

If the silo is to have a diameter of 12 feet or less, the staves should be made of either 2 by 4 material unbeveled on the edges and neither tongued nor grooved, or of 2 by 6 material beveled slightly on the edges to make the staves conform to the circular shape of the silo. If the silo is to have a diameter of more than 12 feet, the staves should be of 2 by 6 material and neither beveled nor tongued and grooved on the edges. * * * The staves should be surfaced on the inside so that a smooth face may be presented which will facilitate the settling of the silage. * * * The first stave set up should be made plumb and should be toe nailed at the top to one of the posts originally set. * * * Immediately a stave is set in place it should be toe nailed at the top to the preceding stave set. It has been found that the work of setting up and preserving the circular outline may be materially aided by the use of old barrel staves (see fig. 3). For a silo 12 feet in diameter the curve in the stave of the sugar barrel is best adapted; for a 16-foot silo the flour barrel stave is best, and for a silo 20 feet or more in diameter the stave of the cement barrel is best. * * * If when the silo staves are put in place they are toe nailed securely to

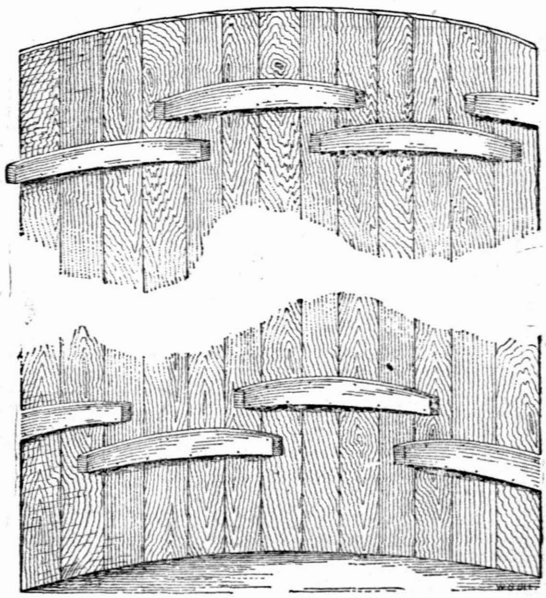

FIG. 3.—How barrel staves may be used in setting up a silo. The staves should be removed before the silo is filled.

the ones previously set; if they are fastened firmly to the permanent upright posts (fig. 2, *a, a, a, a*); if the barrel staves are used as directed above, the silo will have sufficient rigidity to stand until the hoops are put in place. However, if it becomes necessary for any reason to delay for any considerable time the putting on of the hoops, boards should be nailed across the top of the silo.

When it is found impossible to secure staves of the full length desired, a joint or splice must be made.

For a silo 30 feet deep, staves 20 feet in length may be used. A part of these should be used at their full length and part should be sawed through the middle, thus making staves of 20 and 10 feet length. In setting them up the ends which meet at the splice should be squared and toe nailed securely together. They should alternate so that first a long stave is at the bottom then a short one, thus breaking joints at 10 feet and 20 feet from the base.

For the hoops five-eighths inch round iron or steel rods are recommended, although cheaper substitutes have been found very satisfactory. Each hoop should be in three sections for a silo 12 feet in diameter; in four sections for a silo 16 or more feet in diameter.

If the method of construction shown in fig. 2 is followed, then the hoops will need to be in four sections each, the ends being passed through the upright 6 by 6 posts and secured by heavy washers and nuts. * * * The bottom hoop should be about 6 inches from the base of the silo; the second hoop should be not more than 2 feet from the first; the third hoop 2½ feet from the second, the distance between hoops being increased by one-half foot until they are 3½ feet apart, which distance should be maintained except for the hoops at the top of the silo, which may

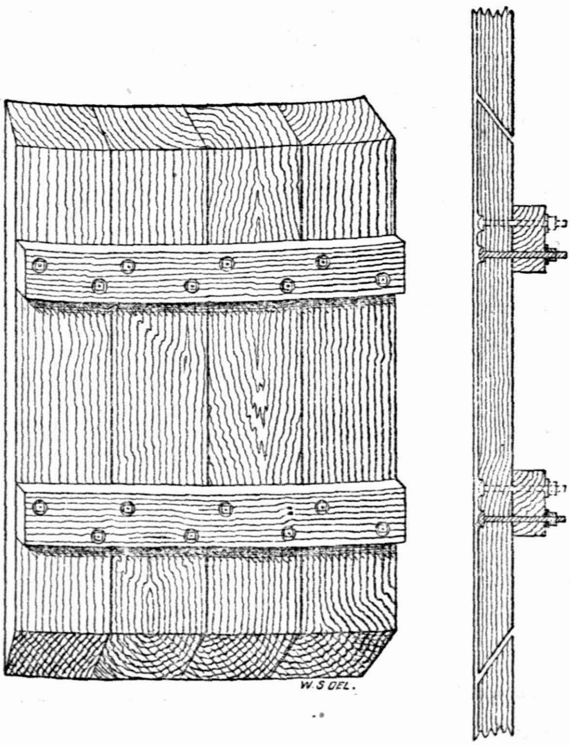

FIG. 4.—Appearance of door of stave silo after being sawed out, and side view of door in place. The cleats *c c* are on outside of door.

be 4 feet apart. * * * To hold both the hoops and the staves in place during the summer when the silo is empty, staples should be driven over the hoops into the staves.

The hoops should be drawn fairly tight before the silo is filled, but not perfectly tight. They must be tight enough to close up the space between the staves, thus preventing any foreign matter from getting into the cracks which would prevent the staves from closing up as they swell, thus allowing air to enter. * * * The hoops should be watched very closely for a few days after the silo is filled. If the strain becomes quite intense, the nuts should be slightly loosened. If during the summer when the silo is empty and the staves thoroughly dry the hoops are tightened so that the staves are drawn closely together, when the silo is filled and the wood absorbs moisture and begins to swell the hoops must be eased somewhat to allow for the expansion.

The doors, 2 feet wide by $2\frac{1}{2}$ feet high, should be located where convenience in feeding dictates.

The lower door should be between the second and third hoops at the bottom and other doors will usually be needed in every second space between there and the top, except that no door will be needed in the top space, as the silage when settled will be sufficiently low to enable it to be taken out at the door in the space below. Plans should be made for the doors at the time the staves are set. When the place

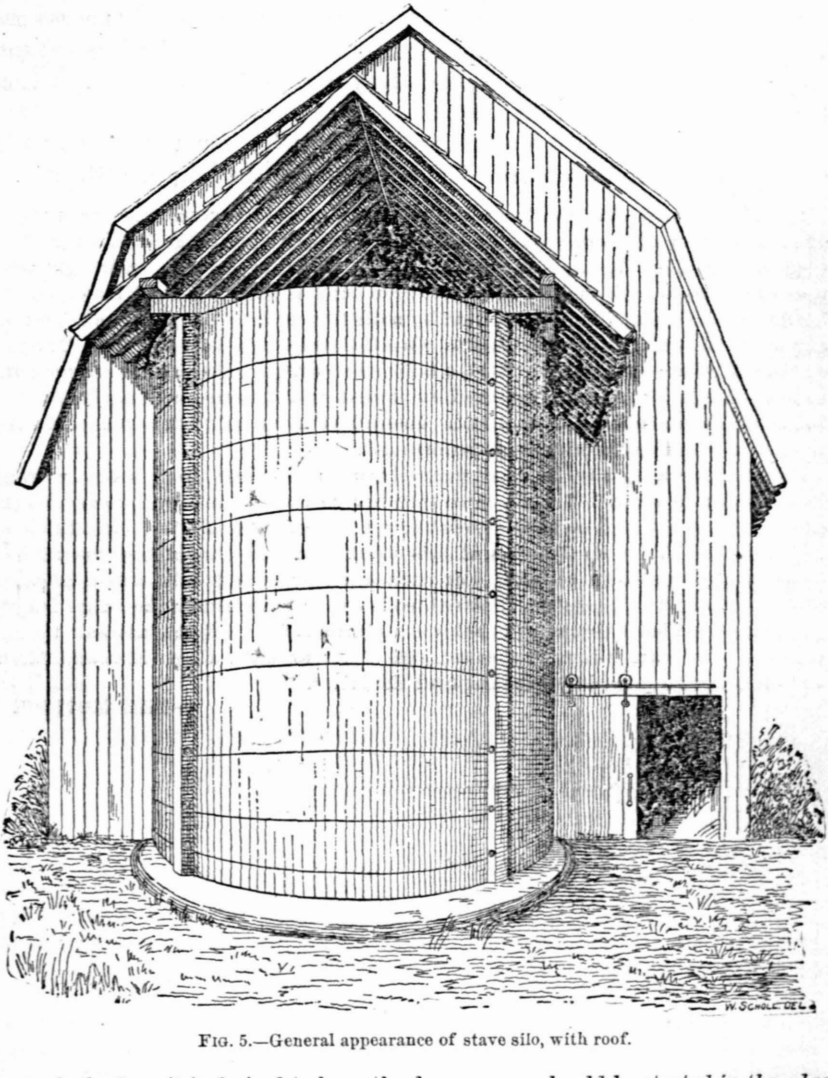

FIG. 5.—General appearance of stave silo, with roof.

is reached where it is desired to have the doors, a saw should be started in the edge of the stave at the points where the top and bottom of the doors are to come. The saw should be inserted so that the door can be sawed out on a bevel, making the opening larger on the inside of the silo. (See fig. 4.) This will enable the door to be removed and put in place only from the inside, and when set in place and pressed down with silage the harder the pressure the tighter will the door fit. * * * After the silo is set up and the hoops have been put on and tightened the

cutting out of the doors may be completed. * * * Before cutting out the doors cleats 2 inches by 3 inches, and in length equal to the width of the door, should be made which will conform to the circular shape of the silo. One of these cleats should be securely bolted to the top and one to the bottom of where the door is to be cut. (See fig. 4.) After the bolting the door may be sawed out, and it is then ready for use. When set in place at time of filling the silo a piece of tarred paper inserted at the top and bottom will fill the opening made by the saw and prevent the entrance of any air around the door.

If the silo is built outside of the barn some sort of roof is necessary. This should be sufficiently wide to protect the walls of the silo as thoroughly as possible. A very satisfactory roof is shown in fig. 5. Other forms have been found effective.

The construction of a much simpler stave silo than the above, without doors and roof, is described in a bulletin of the Virginia Station:

A circle 16 feet in diameter is marked on the ground and covered with short pieces of plank. Four pieces of plank 16 feet long, 6 inches wide, and 2 inches thick are then set on end on the circle at equal intervals. These are held in an upright position by braces in various directions. An iron band is placed about 1 foot from the bottom of the silo and held in position by nails driven into the plank and bent up and over the band. A second band is placed about 1 foot from the top. The rest of the staves are then set in place, a nail being driven into each to support the bands. The latter are then tightened somewhat and 3 more put on, the distance between the bands being about 4 feet. Instead of hoops of round iron ordinarily used, bands made as follows are recommended:

Procure (as can usually be done) partially worn tire iron from heavy wagons. Get a smith to rivet, not weld, these together so that 2 bands will go around the silo. Rivet to the ends of these bands short pieces of iron one-half inch thick by 2 inches wide. Turn up 3 inches of this thick iron and punch three-fourth inch holes in the turned-up portion. For each band procure 2 bolts a foot long and three-fourth inch in diameter. Have threads cut on bolts nearly the entire length, and place these bolts through the holes in upturned ends; put on nuts and tighten the silo. These are stronger, cheaper, and easier to work than the round bands, and considered a great improvement over the latter.

—THE EDITOR.

EXPLANATION OF TERMS.

TERMS USED IN DISCUSSING FERTILIZERS.

Complete fertilizer is one which contains the three essential fertilizing constituents, i. e., nitrogen, phosphoric acid, and potash.

Nitrogen exists in fertilizers in three distinct forms, viz, as organic matter, as ammonia, and as nitrates. It is the most expensive fertilizing ingredient.

Organic nitrogen is nitrogen in combination with other elements either as vegetable or animal matter. The more valuable sources are dried blood, dried meat, tankage, dried fish, and cotton-seed meal.

Ammonia is a compound of nitrogen more readily available to plants than organic nitrogen. The most common form is sulphate of ammonia, or ammonium sulphate. It is one of the first products that results from the decay of vegetable or animal substances.

Nitrates furnish the most readily available forms of nitrogen. The most common are nitrate of soda and nitrate of potash (saltpeter).

Phosphoric acid, one of the essential fertilizing ingredients, is derived from materials called phosphates. It does not exist alone, but in combination, most commonly as phosphate of lime in the form of bones, rock phosphate, and phosphatic slag. Phosphoric acid occurs in fertilizers in three forms—soluble, reverted, and insoluble phosphoric acid.

Potash, as a constituent of fertilizers, exists in a number of forms, but chiefly as chlorid or muriate and as sulphate. All forms are freely soluble in water and are believed to be nearly, if not quite, equally available, but it has been found that the chlorids may injuriously affect the quality of tobacco, potatoes, and certain other crops. The chief sources of potash are the potash salts from Stassfurt, Germany—kainit, sylvinit, muriate of potash, sulphate of soda, and sulphate of potash and magnesia. Wood ashes and cotton-hull ashes are also sources of potash.

TERMS USED IN DISCUSSING FOODS AND FEEDING STUFFS.

Water is contained in all foods and feeding stuffs. The amount varies from 8 to 15 pounds per 100 pounds of such dry materials as hay, straw, or grain to 80 pounds in silage and 90 pounds in some roots.

Dry matter is the portion remaining after removing or excluding the water.

Ash is what is left when the combustible part of a feeding stuff is burned away. It consists chiefly of lime, magnesia, potash, soda, iron, chlorin, and carbonic, sulphuric, and phosphoric acids, and is used largely in making bones. Part of the ash constituents of the food is stored up in the animal's body; the rest is voided in the urine and manure.

Protein (nitrogenous matter) is the name of a group of substances containing nitrogen. Protein furnishes the materials for the lean flesh, blood, skin, muscles, tendons, nerves, hair, horns, wool, casein of milk, albumen of eggs, etc., and is one of the most important constituents of feeding stuffs.

Gluten is the name given to one of the most important of the nitrogenous substances classed together under the general term "protein." "Wheat gum," obtained by carefully chewing wheat, is a familiar example. It is the gluten of flour that gives consistency to dough.

Carbohydrates.—The nitrogen-free extract and fiber are often classed together under the name of carbohydrates. The carbohydrates form the largest part of all vegetable foods. They are either stored up as fat or burned in the body to produce heat and energy. The most common and important carbohydrates are sugar and starch.

Fiber, sometimes called crude cellulose, is the framework of plants, and is, as a rule, the most indigestible constituent of feeding stuffs. The coarse fodders, such as hay and straw, contain a much larger proportion of fiber than the grains, oil cakes, etc.

Nitrogen-free extract includes starch, sugar, gums, and the like, and forms an important part of all feeding stuffs, but especially of most grains.

Fat, or the materials dissolved from a feeding stuff by ether, is a substance of mixed character, and may include, besides real fats, wax, the green coloring matter of plants, etc. The fat of food is either stored up in the body as fat or burned to furnish heat and energy.

MISCELLANEOUS TERMS.

Alkali soils.—Soils found in arid or semiarid regions, which contain an unusual amount of soluble mineral salts (alkali), which effloresce or bloom out in the form of a powder or crust in dry weather following rains or irrigation. Two distinct classes of alkali are known: Black alkali, composed largely of carbonate of soda, which is highly corrosive and destructive to vegetation; and white alkali, composed largely of sulphate of soda and common salt, which is less harmful.

Culture, as here applied to bacteria or other organisms, is the product of their growth under artificial conditions.

Pure culture is a culture containing one kind of organism. Pure cultures of yeast are used in wine making, and pure cultures of bacteria are used in butter and cheese making, and for other purposes, to insure a uniform product.

Sterilized milk or cream, properly speaking, is that in which all the germs have been destroyed (usually by repeated heating to 212° F.—boiling point), but in dairy practice the term is applied to milk or cream which has been heated once to a temperature of about 212° F.

Pasteurized milk or cream is that which has been heated to a temperature (about 155° F.) which does not kill all the bacteria, but only those which are in a vegetating condition and ready to begin their activity at once.

Pollen.—The powdery substance, usually yellow or brown, which falls from flowers when they are shaken. It must be brought in contact with the ovules borne within the pistil and unite with them in order to fertilize the flower.

Pistil is the ovule-bearing organ of the flower. It is often called the fertile or female organ.

Ovules are bodies which, when acted upon by pollen, become seeds.

Pollination is the act of conveying pollen to the stigma. Pollination may be brought about either by natural agencies, such as wind, insects, etc., or by artificial means.

Stigma.—That part of the pistil which receives the pollen for the fecundation of the ovules. It is usually at the extremity of the style or may replace it.

Style.—Part of the pistil, not always present.

Cross-pollination, as here used, means the conveying of pollen to pistils of flowers of a plant of another variety. In case of plants propagated by seeds it also means the transfer of pollen to a pistil of another plant of the same variety.

Fecundation is the action of pollen upon the ovules, rendering them capable of becoming seeds.

Self-fertile plants or varieties are those capable of self-fecundation.

Self-sterile plants or varieties are those incapable of self-fecundation.

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